



A landsystems approach to understanding the evolution of ice-cored topography and distribution of retrogressive thaw slumps, western Canadian Arctic

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The landscape of the Tuktoyaktuk Coastlands, western Canadian Arctic is dominated by glacial and geocryological processes that have modified, imprinted and sculpted the surface, depositing surficial materials upon underlying bedrock. Climate warming continues in this region at a rate that is twice the global average, and retrogressive thaw slump (RTS) activity is increasing. Recently, RTS distribution was associated with glacial limits reached by the Laurentide Ice Sheet and corresponding morainal deposits, but RTS are common in other local terrain units. In this glacial-marginal region, permafrost existed pre-glacially, and non-glacial geomorphic processes occurred throughout the Late Quaternary. Superimposed on these conditions are the effects of thermokarst during the Holocene climatic optimum, followed by a period of cooling. Collectively, these processes and associated forms and deposits have contributed variously to preservation, development, or degradation of permafrost and ground ice. The multifaceted Late Quaternary history in this region has impeded understanding of the distributions of ice-cored topography and RTS. For example, rather than glaciogenic ice, the long reigning regional model for ice-cored topography is according to post-glacial development of intrasedimental segregation-intrusion ice. Toward better understanding the evolution of the whole landscape and the distribution of climate-sensitive terrain, we use a landsystems approach as a means to understand how the ice-cored topography developed where RTS form, through analysing the cryostratigraphy. To this end, we identify 6 RTS representing a suite of ice-cored topographic settings, including: (i) preserved basal glacial ice facies within clayey diamict that has been thrust and folded by glacial push representing morainal deposits of the Sitidgi Stade; (ii) ice contact outwash sediments associated with the Sitidgi Stade, overlying a thermo-erosional contact with underlying basal glacial icy diamict of the Toker Point Stade; (iii) deformed basal glacial ice, eroded down by meltwater-deposited outwash sands some time between the Toker Point and Sitidgi Stades (could be ca. 12.9 kyr BP); (iv) massive, undeformed segregation-intrusion basal ice, likely formed subglacially by freezing of intrasedimental water in pre-existing Pleistocene sands into the base of the glacier, overlain by glacial diamict; (v) deformed basal ice facies of intermediate Toker Point – Sitidgi Stades, with an upper layer that may be supra-glacial melt-out till into which segregated ice formed; and (vi) segregation ice that formed as permafrost aggraded into glaciolacustrine clays deposited in proglacial or glacially dammed basins, that was subsequently eroded down by

glaciofluvial outwash (Sitidgi Stade). To summarize, the distribution of RTS reflects primarily the distribution of icy basal glacial diamict preserved in moraines, but also basal ice and icy basal diamict that are preserved beneath glaciofluvial deposits, segregation ice in glaciolacustrine deposits, and massive segregation-intrusion ice in Pleistocene sands beneath a till plain.